WHAT IS CLAIMED IS:

1. A metathesis catalyst consisting essentially of a transition metal or oxide thereof supported on a high purity silica support, said high purity silica support possessing low amounts of acidic or basic sites such that in a reaction of pure 1-butene over said catalyst under metathesis reaction conditions the reaction possesses a weight selectivity to hexene-3 of at least 55 weight percent.

2. The catalyst of Claim 1 wherein the high purity support possesses less than about 150 ppm magnesium, less than about 900 ppm calcium, less than about 900 ppm sodium, less than about 200 ppm aluminum and less than about 40 ppm iron.

3. The catalyst of Claim 1 wherein the high purity silica is chromatographic grade silica.

4. The catalyst of Claim 1 wherein the weight selectivity to hexene-3 is greater than 60 weight percent.

5. The catalyst of Claim 1 wherein the transition metal or oxide thereof represents from about 1 to about 20 weight percent of the catalyst.

6. The catalyst of Claim 1 where the transition metal or oxide thereof is selected from the group consisting of tungsten, molybdenum, rhenium, or oxides therof and mixtures thereof.

7. A metathesis process comprising providing a feedstock containing one or more olefins and contacting the feedstock with a metathesis catalyst under metathesis reaction conditions which minimize or eliminate double bond isomerization reactions to provide a metathesis reaction product, wherein the metathesis catalyst consists essentially of a transition metal or oxide thereof supported on a high purity silica support, said high purity silica support possessing low amounts of acidic or basic sites such that in a reaction of pure butene-1 over said catalyst under metathesis reaction conditions the reaction possesses a weight selectivity to hexene-3 of at least 55 weight percent.

8. The process of Claim 7 wherein the feedstock contains at least one olefin selected from the group consisting of propylene, 1-butene, 2-butene, 1-pentene, 2-pentene, 2,4,4-trimethyl-2-pentene, 2,4,4-trimethyl-1-pentene, 1-hexene, 2-heptene, 1-octene, 2-nonene, 1-dodecene, 2-tetradecene, 1-hexadecene, 1-phenyl-2-butene, 4-octene, 3-eicosene, 3-hexene, 2-methy-4-octene, 4-vinylcyclohexene, 1,5,9,13,17-octadecapentene, 8-cyclopentyl-4,5-dimetyl-1-decene, and 3-heptene.

9. The process of Claim 7 wherein the feedstock contains butene-1.

10. The process of Claim 7 wherein the high purity silica support possesses less than about 150 ppm magnesium, less than about 900 ppm calcium, less than about 900 ppm sodium, less than about 200 ppm aluminum and less than about 40 ppm iron.

11. The process of Claim 7 wherein the high purity silica support is chromatographic grade silica.

12. The process of Claim 7 wherein the transition metal or oxide thereof represents from about 1 to about 20 % of the catalyst.

13. The process of Claim 7 wherein the transition metal or oxide thereof is selected from the group consisting of tungsten, molybdenum, rhenium or oxides thereof.

14. The process of Claim 7 wherein the weight selectivity to hexene-3 is at least 60 weight percent.

15. The process of Claim 7 wherein the metathesis reaction conditions include a temperature of from about 50°C to about 600°C, a weight hourly space velocity (WHSV) of from about 3 to about 200, and a pressure of from about 10 psig to about 600 psig.

16. The process of Claim 7 wherein the metathesis reaction conditions include a temperature of from about 200°C to about 350°C, a weight hourly space velocity (WHSV) of from about 6 to about 40, and a pressure of from about 30 psig to about 100 psig.

17. The process of Claim 7 wherein the olefin is in the liquid phase.

18. The process of Claim 7 wherein the olefin is in the gas phase.

19. The process of Claim 7 wherein the olefin is contacted with the catalyst for a time period ranging from about 0.1 seconds to about 4 hours.